Audio Player and a Method for Controlling Audio Data by the Audio Player

The invention is relative to an audio player with an interchangeable data carrier and an associated method for controlling audio data by the audio player.

The personal computer (PC) or a device that can be coupled to it has become known as an electronic device capable of multimedia. The term multimedia denotes the cooperation of graphics, sounds and/or text within an application on the computer. Even the output of sound files itself in an application is to be understood under the concept of multimedia.

The development of the multimedia PC made available a computer with which the cooperation of multimedia components was possible. The minimum standard that a computer must meet for multimedia application was defined by the MPC standard, currently MPC 2.

The multimedia PC can be coupled to audio and/or video devices. Such a system, consisting for example of multimedia PC and audio player, has extensive hardware and requires a large footprint. Especially in the case of a music player being used as an audio device the further use of the CD-ROM and of a CD-ROM drive is an obstacle to a previous [sic] reduction in size of the player. The current development of a DVD (Digital Versatile Disk) as data carrier for audio players does bring about a new dimension in storage capacity; however, the use of a drive in known audio players is retained. The disadvantages of mechanically movable components in the

drive and their susceptibility to trouble remain. The CD-ROM is, just as a DVD, an interchangeable data carrier for an audio player. In both instances a drive is always necessary.

EP 0786774 A2 teaches an audio playback and recording device that retrieves data, for example for the playback of music, from a transmitting station and stores it in the device. To this end a hard disk for storing the data is permanently integrated into the device. The hard disk is a disk with drive which disk rotates at a high speed and is 1.8 inches in size in the exemplary embodiment of EP 0786774 A2. The external form of the hard disk component can resemble a card (72) that is permanently integrated in the device. The data is filed on the hard disk up to a play time of approximately 30 minutes and retrieved as needed. If the user wants to be able to retrieve other music selections he must delete the previous data on the hard disk and re-record with data from the transmitting station. The development of larger hard disks up to a capacity of 1 GB which can be permanently integrated in the device (column 10) is viewed as progress to be achieved in the future and as a future goal for the further development of the device of EP 0786774 A2. However, this has the disadvantage that even in this instance the capacity of the hard disk would be limited and would have to be at least partially deleted again. Moreover, such cards are also particularly sensitive to shocks. In addition, EP 0786774 A2 suggests cards (74) for expanded functions such as, for example, for using the device as a fax machine or a navigating device. However, this perpetuates the disadvantages of the

integrated hard disk. Moreover, the cards (74) with the PCMCIA standard are still very large and awkward.

The invention has the problem of developing an audio player which can be operated independently, eliminates an integrated hard disk, a CD-ROM drive or a similar drive operating with movable parts but in which audio player the playback of sounds in hi-fi quality is made possible and in which the storage medium is small and which makes possible a plurality of applications.

A further problem in an advantageous embodiment is to make it possible for the audio player to be selectively operated either independently or coupled to a data source, particularly to a computer or a multimedia PC, a CD player or another playback device.

A further problem is to avoid the above-mentioned disadvantages.

The problems are solved in accordance with the features of claim 1 and the features of claim 10.

It is advantageous if the audio player (player) has a slot for a multimedia card (called MM cards in the following). The MM card contains at least one microprocessor for data control and contains a memory, in particular a flash memory. Additional or alternative other memories such as ROM and/or RAM components are also possible but not necessarily required. If the audio player has several slots for MM cards the storage capacity is further raised since data information can be recalled either simultaneously or successively.

The previously known cards are PC cards according to the PCMCIA standard. The novel MM card is used as an interchangeable data carrier for the audio player and replaces the CD-ROM with the CD-ROM drive or any other permanently integrated hard disk in the device. This achieves a great advantage because mechanically stressed parts of the drive can be eliminated in a general fashion. This reduces the total sensitivity of the player to shocks. The MM card is also significantly smaller in its dimensions and thus more space-saving than a PC card according to the PCMCIA standard. However, it is also basically possible to retain the dimensions of a PCMCIA in that several MM cards are placed on a carrier with such dimensions or the active carrier [the carrier for legends] has these dimensions.

The MM card is a data carrier for at least audio data. Audio data can be converted into sounds such as music or language. In a special embodiment of the player it can be additionally equipped with a signal processor that realizes an algorithm for converting preferably compressed text data into audio data. This signal processor can be controlled by the microcontroller of the audio player. The playback of this audio data is performed as language. This makes it possible to convert text data that is also stored on the MM card into audio data and finely into language. This corresponds to a "speaking book". This cooperation between text data and audio data via the card as data carrier results in the formation of the concept of the MM card.

The player can be operated independently or preferably in conjunction with a multimedia PC.

The data connection between the data source, preferably a computer or a multimedia PC, and audio player takes place via an interface, in particular a serial interface. This interface could be a serial interface according to the RS 232 standard, preferably according to the USB standard. USB denotes the Universal Serial Bus, which makes possible a genuine hot plug-and-play. The multimedia PC communicates via the serial interface with the microcontroller of the audio player. In order to fulfill control functions the microcontroller also comprises ROM and RAM components. A data connection runs from the microcontroller to the slot for the MM card. When the MM card is introduced into the slot there is a data connection to decompression circuit. This connection comprises a high-speed interface that makes high data transfer rates possible. The decompression circuit has at least one signal processor. There is a connection to a D/A converter from this circuit for the decompression of the audio data. The connection runs further from the D/A converter to a playback unit comprising at least one amplifier and a loudspeaker unit or an earphone unit.

The player makes it possible in an advantageous manner to store compressed audio data from the memory of the multimedia PC on the MM card of the player. This is made possible by a download from the memory of the data source, controlled by the microcontroller of the player. The microcontroller also comprises data connections to a keyboard and

optionally to a display. The keyboard comprises at least known function keys of a music player.

The audio data is stored on the MM card in a highly compressed manner. The data reduction corresponds at least to the method according to MPEG II layer 3. The higher the compression rate of the audio data, the longer the playing time is. The more information is stored, the higher the playback quality is. Audio data represents sounds such as music or language.

The compressed audio data can be transferred to the decompression circuit for decompression during the cooperation between the microcontroller and the microprocessor of the MM card (or an ASIC [defined below as "user (application) circuit"] circuit via the indicated connection. This process can be initiated by activating the "Play" key on the keyboard of the player. The compressed audio data is read out of the flash memory of the MM card thereby.

The signal processor of the decompression circuit makes a high processing speed possible which is supported by the high-speed interface. The decompression circuit feeds the D/A converter via a connection. The signals formed are supplied from the D/A converter to a playback unit. The playback unit comprises at least one amplifier and a loudspeaker unit and makes possible the playback of sounds during play.

The method for controlling audio data can

- Transfer audio data from a data source onto an MM card as data carrier in order to play this data from there by the audio player; in a further development even text data can be transferred to and stored on the MM card and be converted there into audio data, and/or

- Play audio data already stored in a compressed manner in an MM card inserted in the slot for playback by the audio player, and/or

- Play audio data from the data source directly in the audio player.

The audio data for the audio player is supplied by means of an interchangeable data carrier or, in particular, via a serial interface. The supplied audio data is already compressed or becomes compressed and is transported by a microcontroller of the audio player as compressed audio data from a memory of a data source into a memory of the MM card, where it is stored. Audio data compressed by the microprocessor of the MM card from the memory of the MM card is transported directly or via the microcontroller to a decompression circuit with a control, decompressed there and then supplied via a D/A converter to a playback unit. Compressed audio data is transported from a memory of the data source to the decompression circuit, decompressed there and then supplied via the D/A converter to the playback unit.

The audio player with the method for controlling audio data makes possible in an advantageous manner the playback of sound in hi-fi quality.

The compressed audio data can be selectively transmitted at various data transfer rates to the decompression circuit. This makes it possible to achieve different playback qualities and also different amounts of memory. It has proven to be advantageous if the data transfer rate is at least 92 kbits/s.

A random (optional) access to the memory of the MM card is made possible in an advantageous manner via a keyboard of the microcontroller in which case the transmission of audio data is interrupted in particular upon the initiation of a "Forward" or "Back" procedure with the keyboard.

If the interruption of the data transfer is marked in the memory by setting a data marker (pointer, indicator), then the position at which the interruption took place can be found again in a rapid and simple manner.

It is advantageous if a signal processor is controlled in such a manner by program data from the MM card by the microcontroller of the audio player that text data stored on the MM card is converted into audio data.

A further advantageous development of the invention consists in that a signal processor is controlled in such a manner by program data from the MM card by the microcontroller of the audio player that text data stored on the MM card is not converted into audio data but rather is reproduced on a display via the playback unit. This makes the audio player in accordance with the invention even more versatile.

An exemplary embodiment of the invention is described in the following.

Figure 1 shows the most important functional groups of an audio player and their data connections.

Figure 1 is limited to the most important functional groups essential for an understanding of the operation of the invention. It can be recognized that audio player 1 comprises slot 2 for an MM card 3. MM card 3 replaces the CD-ROM with CD-ROM drive or hard disk which were previously customary in audio players.

In order to make possible a cooperation with the player a microprocessor (or an ASIC, that is, a user [application] circuit) for control and a memory, in particular a flash memory, are integrated on the MM card. Resources for driving the flash memory are saved in audio player 1 by the integrated microprocessor. The flash memory can be written and erased electronically. It comprises, for example, the storage capacity of 4 MB on the MM card. This exceeds the CD-ROM memory of previous audio players.

The MM card can be manually exchanged, that is, replaced by virtue of slot 2. Card 3 and slot 2 have the necessary contacts, which are closed when card 3 is inserted. In comparison to any drive, the MM card 3 is not sensitive to shocks and is resistant to its environment. This data carrier (MM card) is significantly smaller than a credit card and thus smaller than previously known PC cards in accordance with the PCMCIA standard.

However, the MM card can also be designed according to the geometric dimensions of the PCMCIA standard.

Audio player 1 has, for example, an RS 232 interface 12 (a USB interface would also be possible, for example) in order to make possible a coupling to a data source that is designated in the following as a multimedia PC 11. This interface is not obligatorily required but is logical if cooperation with a data source is required. This is described elsewhere.

Audio player 1 has at least one microcontroller 8. This microcontroller 8 is connected via data and control lines to RS 232 interface 12 which, on the other hand, has a connection to multimedia PC 11. There is another connection with transmission path VOV 1 to compression circuit 4. A transmission path between the points VO, V1, V2 has a purely symbolic character and is intended to represent necessary possibilities of connection for the transport of audio data and control signals with only a minimum of sketching.

It can also be provided in a special embodiment that data is read out of the MM card 3 via the path V2VO and controlled in microcontroller 8. The control can concern, for example, the right to play, right to use or copy protection. After a positive control the data is then forwarded to decompression circuit 4 via path VOV1.

Furthermore, microcontroller 8 comprises a connection to keyboard 10 and, optionally, display 9. Display 9 could be eliminated for economic reasons. The keyboard comprises at least the keys for known basic functions

of a music player. Furthermore, there are control and data connections from microcontroller 8 via transmission path VOV2 to slot 2 and thus to the microprocessor and to the flash, RAM or ROM memories of MM card 3.

There is a connection via slot 2 to current supply 13, which supplies the integrated components on MM card 3 with energy. On the other hand there is a data connection with transmission path V2V1 from flash memory card 3 to decompression circuit 4. This circuit assumes the function of a decoder for decompressing audio data. It is therefore provided with at least one signal processor. The output of decompression circuit 4 is connected via connection lines to D/A converter 5 that can advantageously be a stereo D/A converter. The output of the D/A converter is connected to playback unit 7. The latter comprises at least one amplifier 6 and, after its output, a loudspeaker unit, preferably stereo loudspeaker 7.1, 7.2. Alternatively, earphones or both can be used for the loudspeaker unit. The playback unit is capable of producing sounds like language or music.

The method for controlling audio data by audio player 1 utilizes microcontroller 8. If a multimedia PC 11 is connected via RS 232 interface 12 microcontroller 8 has access to the memory of multimedia player PC 11. The method operates with audio data compressed according to the MPEG II layer 3 standard. A powerful compression method is particularly advantageous since enormous amounts of data must be processed during the processing of audio data.

The compressed audio data from multimedia PC 11 can be transmitted via transmission path VOV2 into the memory of the MM card 3 by a download controlled by microprocessor 8 in cooperation with multimedia PC 11 and stored there. If compressed text data is being transmitted, it can also be stored on the MM card. Before being re-transmitted, this text data must be converted by the signal processor of the MM card into audio data which is then available for further processing. The algorithm of the signal processor on the MM card can also be designed in such a manner that it optionally suppresses a conversion of the text data into audio data and brings the playback of the decompressed text data onto a screen display so that a page-by-page presentation of the text becomes possible (not shown in figure 1).

Alternatively, a transfer of data to decompression circuit 4 can take place from this or another MM card provided with other audio data stored in a compressed manner. This process can be initiated, for example, by actuating the "Play" key on keyboard 10. This causes the compressed audio data to be read out of the memory of the MM card 3 and transmitted to the compression circuit. Transmission path V2V1 from MM card 3 to compression circuit 4 is supported by a high-speed interface.

This data stream can be transmitted at different data-transfer rates, approximately 92 kbit/s, preferably approximately 128 kbit/s. Compression circuit 4 is a decoder for decompressing the audio data.

There is also the possibility that compressed audio data is transmitted to multimedia PC 11 over transmission path VOV1 directly (without MM card 3) to compression circuit 4. The compressed circuit has a signal processor that guarantees a high processing rate. The signal processor realizes the implemented decompression algorithm. Compression circuit 4 can be integrated with microcontroller 8 in an IC so that there is a common component. This makes possible an especially small and economical design of the audio player.

From the decompression circuit the decompressed data is supplied to a D/A converter 5. The latter is preferably a stereo D/A converter. The signals obtained at its output are supplied to playback unit 7. The latter consists of at least one amplifier 6 and a loudspeaker unit with preferably stereo loudspeakers 7.1, 7.2 and/or with stereo earphones.

It can be provided that microcontroller 8 interrupts the transmission of audio data upon the initiation of a process, e.g., "Forward" or "Back" by keyboard 10. This avoids an uncontrolled playback of data during this operation of the device.

If the interruption of the transmission of data is marked in memory 3 by setting a data marker then the position at which the interruption was made can be found again in a rapid and simple manner. This makes it possible to jump back and forth between several positions in the memory.

The described audio player can also be combined in the sense of a combined device in a unit with a CD player, DVD player or a similar device.

Data from traditional devices can be used in this instance to play the MM card. The MM card can subsequently be removed from the combined device and inserted into a portable audio player. It can be sufficient in this instance if the audio player in the combined device is designed only as a receiving device for playing the MM card. In a further development of the invention a coupling point of the audio player to a stationary CD player or similar playback device is provided. The audio player is coupled to the stationary device for receiving and/or playing back the MM cards. This can permit an improved playback of the data. The coupling takes place by a connection of the stationary device with microcontroller 8 and/or with the output of D/A converter 5.

It is particularly advantageous if the audio player is designed using an "embedded application". This avoids having to use an expensive bus structure which would increase, in particular, the cost of the device. This does limit the functionality since only the one functionality filed can be performed; however, this avoids an operating system like the one which would be necessary in a PC-like structure or a bus. In particular, this reduces the cost.

Further functions can be realized with the audio player by using a large graphics display. Thus, for example, played-back music can be graphically supported.

The audio player can be universally used by using a platform-independent programming language such as, e.g., JAVA. This makes it

possible for the decompression of the data on the card to take place independently of the product. A special embodiment of the audio player can provide that the MM card is introduced almost completely into the audio player. This avoids a damaging of the MM card. If the insertion into the audio player is closed with a slide, this assures that the MM card is protected from falling out or being contaminated. This can be especially important if the audio player is to be used in a rough environment. Since MM cards can be very small, this offers reliable protection against the loss of the MM card.

The invention is not limited to the exemplary embodiment described. Variations of the exemplary embodiment in the sense of the patent claims also fall under the scope of the invention.